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TI Alloy brazing fillers for joining of semiconductor devices
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PA Sumitomo Metal Mining Co., Ltd., Japan
SO Jpn. Kokai Tokkyo Koho, 5 pp.
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AB The alloy brazing fillers contain mainly Sn, 0.05-3.5% Ag, and 0.1-2.0% of elements whose decomposing temperature is higher than the m.p. of Sn. The elements are preferably ≥1 of Au, Cr, **Co**, **Cu**, Ni, Pd, Pt, Rh, Se, and Te. After soldering, intermetallic compds. with maximum grain diameter 5-80 μm can be formed in the joining parts of the brazing fillers. The brazing fillers have good appearance and are especially suitable for semiconductor device fabrication.

0.1-2 Cu
0.1-2 Co
0.1-2 Ni
0.05-3.5 Ag

Sn

PATENT ABSTRACTS OF JAPAN

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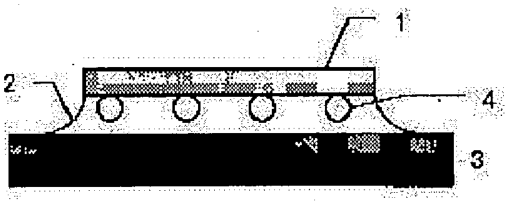
(54) ALLOY BRAZING FILLER METAL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a alloy brazing filler metal having a function capable of stabilizing the thickness of a brazing filler metal layer after joining without increasing working stages, thus, at a cost equal to the conventional one.
SOLUTION: This alloy brazing filler metal uses an alloy brazing filler metal essentially consisting of Sn and containing, at need, Ag of 0.05 to 3.5% by a weight concentration as a base, contains elements having a decomposing temperature higher than the melting point of Sn such as Au, Cr, Co, Cu, Ni, Pd, Pt, Rh, Se and Te of 0.1 to 2.0%, and in which intermetallic compounds of which the maximum particle size lies in the range of 5 to 80 μm are also present.



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CLAIMS

[Claim(s)]
[Claim 1] Alloy wax material which makes Sn a subject, uses as the base the alloy wax material which contained 0.05 - 3.5% for Ag by weight concentration if needed, contains an element with decomposition temperature higher than the melting point of Sn 0.1% to 2.0%, and is characterized by being within the limits whose maximum grain size of the existing intermetallic compound is 5-80 micrometers.
[Claim 2] Alloy wax material according to claim 1 characterized by using any one sort in Au, Cr, Co, Cu, nickel, Pd, Pt, Rh, Se, and Te as an element with decomposition temperature higher than the melting point of Sn.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is alloy wax material which is used in order to join the metal or the nonmetal material in which the metal layer was formed on the metallic material or the front face and whose Sn is the main element, and relates to the alloy wax material used for junction which is expected to control the thickness of the wax material layer after joining.
[0002]
[Description of the Prior Art] In the assembly of a semiconductor device like a transistor or IC, as shown in drawing 1 , it may join to Cu or Cu using the alloy wax material which made Sn the subject on the substrate which performed nickel and Ag plating for the silicon chip in which the thin film of Au or Ag was formed at the rear face.
[0003] At this time, a wax material layer eases the stress which originates in the difference of the coefficient of thermal expansion of the silicon chip by the heat generated with intermittence actuation of a semiconductor chip, and a substrate, and is generated, and is bearing the important role of telling and radiating promptly the heat generated in it and coincidence to a substrate side. Since it becomes impossible to ease thermal stress when the wax material layer after this junction is too thin, and heat leakage nature will fall if too conversely thick, to make thickness of a wax material layer into for 10 to 100 micrometers is desired.
[0004] As a means to adjust a wax material layer to such thickness, there is an approach given [for example,] in JP,6-155081,A. Namely, the thickness of a solder layer is stabilized at the time of die bonding by putting the heat-resistant minute particle of predetermined particle size, such as a silica, in the middle of the solder of a bilayer.
[0005] However, it is necessary to use the solder which piled up another solder on it and was made to unify through a rolling mill, preparing two hoops of the solder once fabricated with strip processing in this case, and applying a minute particle to solder of one of the two.
[0006] However, after the usual alloy wax material for semiconductor device assemblies creates an ingot by dissolution casting, it is cast by the desired configuration through extruding, strip processing, and shearing-work ******.
[0007] For this reason, since said process which puts a minute particle is needed after strip processing, and a production process increases, wax material between which the heat-resistant minute particle was put has the problem that it cannot but become expensive compared with the conventional wax material.
[0008]
[Problem(s) to be Solved by the Invention] From the above thing, this invention makes it a technical problem to provide at the cost which is not different from the former in the alloy wax material which has the function which can stabilize the thickness of the wax material layer after junction, without [therefore] increasing a processing process.
[0009]
[Means for Solving the Problem] This invention which solves the above-mentioned technical problem is alloy wax material which makes Sn a subject, uses as the base the alloy wax material which contained 0.05 - 3.5% for Ag by weight concentration if needed, contains an element with decomposition temperature higher than the melting point of Sn 0.1% to 2.0%, and is characterized by being within the limits whose maximum grain size of the existing intermetallic compound is 5-80 micrometers.
[0010] Moreover, as an element with decomposition temperature higher than the melting point of Sn, it is

desirable to coincidence that it is an element with an affinity weaker than Sn with oxygen, for example, Au, Cr, Co, Cu, nickel, Pd, Pt, Rh, Se, and Te are in it. Te is desirable at the simplicity of the handling also in being such.

[0011]
[Embodiment of the Invention] The maximum grain size of the intermetallic compound which the alloy wax material of this invention made Sn the subject, used as the base the alloy wax material which contained Ag in 0.05 - 3.5% or less of range if needed, and added the element which forms an intermetallic compound with decomposition temperature higher than Sn 2.0% from 0.1%, and was generated at the processing process is a thing within the limits which are 5-80 micrometers.

[0012] In order to obtain the wax material of this invention, after carrying out presentation preparation, fusing to a predetermined presentation and obtaining an ingot, extruding, strip processing, a shearing work, etc. carry out this ingot, and it considers as the alloy wax material of a desired configuration. Since the intermetallic compound generated in this process exists by the solid state even if it carries out melting of the wax material at the time of junction of a member, as shown in drawing 2 , the board thickness of the wax material layer after junction is controlled as it is also in that magnitude.

[0013] Furthermore, since this intermetallic-compound particle is a thing made to generate in the dissolution casting in the usual alloy wax material production process, it can supply wax material at the cost which a processing process does not increase, therefore is not different from the former.

[0014] In order to make an intermetallic compound generate in wax material and to control the particle size, the molten metal temperature at the time of dissolution casting is controlled. That is, once dissolving all raw material elements completely within crucible, if temperature is lowered gradually, an intermetallic compound with high melting temperature will crystallize from a molten metal. The intermetallic-compound particle crystallized as temperature was furthermore lowered grows, and is made big and rough.

[0015] Therefore, if it slushes into mold after holding molten metal to the temperature from which the crystallized intermetallic-compound particle serves as a desired particle size, or continuous casting is carried out, it quenches and growth of this particle is stopped, the ingot which the intermetallic-compound particle of the magnitude made into the purpose distributed in the alloy is producible. Although considered as the alloy wax material of a desired configuration through extruding, strip processing, a shearing work, etc. after that, since re-melting of the wax material is not carried out at these processing processes, the intermetallic compound generated at the time of ingot production will maintain magnitude as it is, and will be offered.

[0016] Thus, although the produced alloy wax material melts a matrix component with that melting point, the intermetallic compound with the melting point higher than this melting point does not dissolve. Therefore, since an intermetallic-compound particle will exist by the solid state at the time of junction, the thickness of the wax material layer after junction is secured with the particle size, and stable junction also with the small dispersion can be performed.

[0017] Since it is effective in wax material getting wet, and improving breadth nature or raising the mechanical strength of wax material, Ag may be made to contain in the alloy wax material of this invention, although it is not necessary to necessarily contain Ag. However, since the compound with which Sn and Ag were connected will interfere with special effectiveness even if it added the 3rd element and controlled the particle size of an intermetallic compound, in order to be connected with Sn and to generate an intermetallic compound if Ag is also made into the addition exceeding 3.5%, to add Ag, it may be necessary to be 3.5% or less.

[0018] If the 3rd element to add is an element which forms an intermetallic compound with decomposition temperature higher than the melting point of Sn, it is fundamentally good anything. For example, as an element which forms Sn and an intermetallic compound, there are Au, Ba, calcium, Ce, Co, Cu, Fe, La, Li, Mg, Mn, nickel, Pr, Pt, Rh, Se, Sr, Te, Ti, Zr, etc. However, it is better to add the element which an affinity with oxygen is desirably weaker than Sn, namely, cannot oxidize easily rather than Sn. This is because the element oxidizes preferentially, it comes out to the front face of alloy wax material on the occasion of the production process way of alloy wax material, or use, an oxide film is formed and the purpose of an alloying element is not achieved, when the element which is easy to oxidize rather than Sn is added.

[0019] Moreover, although the junction which used alloy wax material is made when the metal of joint material and Sn in alloy wax material connect and alloy If the oxide film of other elements exists in an alloy wax material front face, in order to join without trouble's occurring in this alloying reaction and using an activator like flux for it especially in the assembly of a semiconductor device, It gets wet, and breadth nature gets worse or it is easy to become the factor out of which poor junction comes.

[0020] As an element which cannot oxidize easily rather than Sn among the above-mentioned elements, Au, Cr, Co, Cu, nickel, Pd, Pt, Rh, Se, and Te are raised. The melting point of Te in a simple substance is comparatively low especially, and since alloying is an easy element, without carrying out 2 phase separation when it added and dissolves in Sn, it is suitable as an alloying element.

[0021] However, since it becomes difficult for that addition to maintain at the range of 5 to 80 micrometers the maximum grain size of the intermetallic compound crystallized by controlling the temperature at the time of casting by less than 0.1% if an intermetallic compound does not crystallize, desired effectiveness is not acquired even if it changes various temperature at the time of casting, and 2.0% is exceeded in adding this 3rd element, it is necessary to make it 0.1 to 2.0% of within the limits.

[0022] Moreover, it will become difficult to radiate efficiently the heat which the case where the thickness of the wax material layer after junction will not fulfill 10 micrometers if the maximum grain size of the intermetallic compound to generate is smaller than 5 micrometers occurs, it becomes thickness inadequate for easing thermal stress, the thickness of the wax material layer after junction may exceed 100 micrometers if 80 micrometers is exceeded conversely, and is generated with a silicon chip to a substrate side. For this reason, a maximum grain size needs to make it the range of 5 to 80 micrometers.

[0023]

[Example] Next, this invention is further explained using an example.

(Examples 1-11) After blended with the alloy presentation shown in 1-11 of Table 1 (examples 1-11), putting into graphite crucible, dissolving in atmospheric air with the RF induction fusion furnace, casting Sn, Ag, and a tellurium to water-cooled mold at the casting temperature of the 1st table and making them into an ingot, thickness was set to 100 micrometers with extruding and strip processing, and it was processed by piercing for the square whose die length of one more side is 3mm.

[0024] Using these alloy wax material, in nitrogen-gas-atmosphere mind, it is on [of 270 degrees C] a heater block, and joined to the copper plate with which the silicon chip of the square whose die length of one side in which the golden vacuum evaporationo film was formed on substrate nickel and a front face is 5mm was given to plating of Ag on substrate nickel and a front face. The junction sample of ten points was produced to each alloy wax material, cross-section polish was performed, and the thickness of the solder after junction was investigated. Consequently, when it joined using this invention alloy wax material as shown in Table 2, the thickness of solder was secured with the intermetallic compound which exists in solder, and it turned out that dispersion in the thickness is small in the range whose addition of Te is 0.1 - 2.0%. In addition, in this example, it checked that the intermetallic compound with which Te is connected with Sn and becomes SnTe was formed by the X-ray microanalyser.

[0025] (Examples 1-4 of a comparison) After blended with the alloy presentation shown in the data numbers 12-15 of Table 1, putting into graphite crucible, dissolving in atmospheric air with the RF induction fusion furnace, casting Sn, Ag, and a tellurium to water-cooled mold at the casting temperature of the 1st table and making them into an ingot, thickness was set to 100 micrometers with extruding and strip processing, and it was processed by piercing for the square whose die length of one more side is 3mm. In addition, when 12 and 13 did not add Te or make it fewer than the range of this invention (examples 1 and 2 of a comparison), 14 and 15 are the cases (examples 3 and 4 of a comparison) where more Te than 2% is added.

[0026] The silicon chip was joined like the example using these alloy wax material. The junction sample of ten points was produced to each alloy wax material, cross-section polish was performed, and the thickness of the solder after junction was investigated. The result was shown in the data numbers 12-15 of the 2nd table. When it joined using this invention alloy wax material, thickness with the addition of Te sufficient by 0.05 or less was not obtained, but at 3.0% or more, it was too thick, and the table showed that dispersion also became very large. In addition, formation of the intermetallic compound which becomes SnTe also in this example of a comparison was checked.

[0027]

table 1 Sample Alloy presentation Casting temperature Particle size of a Sn-Te intermetallic-compound particle Number Unit: % of the weight Unit : [degree C] (20 points are measured to arbitration) Unit : micrometer Ag Te Sn The average Maximum Minimum value 1 3.0 0.1 Remainder 600 5.0 15.0 2.0 2 3.0 0.3 Remainder 600 8.5 20.0 4.0 3 3.0 0.3 Remainder 700 8.0 17.04.0 4 2.0 0.3 Remainder 600 8.5 18.0 3.5 5 3.0 0.5 Remainder 600 9.0 25.0 7.56 3.0 0.5 Remainder 700 9.0 20.0 5.0 7 2.0 0.5 Remainder 600 9.5 22.5 6.0 8 3.0 1.0 Remainder 600

15.0 32.5 7.5 9 3.0 1.0 Remainder 700 12.0 32.0 5.0 10 2.0 1.0 Remainder 600 17.0 35.0 7.5 11 3.0 2.0 Remainder 600 19.0 55.0 5.0 12 3.0 0 Remainder 600 It does not exist. It does not exist. It does not exist. 13 3.0 0.05 Remainder 600 1.2 2.0 1.0 14 3.0 3.0 Remainder 600 25.0 90.0 10.015 3.0 4.0 Remainder 600 30.0 125.0 10.0 [0028]

2nd Table Sample An alloy presentation The thickness of the wax material layer after junction Number Unit : [% of the weight] (Thickness average for each core of ten samples) Unit : micrometer Ag Te Sn Average Maximum Minimum value Dispersion 1 3.0 0.1 Remainder 12.0 24.0 10.014.0 2 3.0 0.3 Remainder 20.032.5 15.5 17.0 3 3.0 0.3 Remainder 17.5 25.0 15.0 10.0 4 2.0 0.3 Remainder 16.0 20.0 8.5 12.0 5 3.0 0.5 Remainder 30.0 35.0 16.0 19.0 6 3.0 0.5 Remainder 27.5 32.0 15.0 17.0 7 2.0 0.5 Remainder 32.0 30.0 17.5 12.5 8 3.0 1.0 Remainder 37.0 38.0 22.5 15.5 93.0 1.0 Remainder 35.0 35.0 25.0 10.0 10 2.0 The 1.0 remainder 38.0 40.0 24.0 16.0 11 3.0 2.0 Remainder 45.0 50.0 30.0 20.0 12 3.0 0 Remainder 5.0 15.0 1.0 14.0 13 3.0 0.05 Remainder 6.0 15.0 2.0 13.0 14 3.0 3.0 Remainder 42.5 80.0 27.0 43.0 15 3.04.0 Remainder 52.0 110.0 35.0 75.0 [0029]

[Effect of the Invention] As explained above, in order to make an intermetallic-compound particle intervene, by the alloy wax material of this invention, dispersion in the thickness of the solder layer obtained after junction becomes small. Moreover, since the alloy wax material of this invention is producible by the completely same production process as the conventional alloy wax material, it is not accompanied by the rise of a manufacturing cost. Therefore, the assembly yield can be improved in semiconductor device assembly, without raising member cost.

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TECHNICAL FIELD

[Field of the Invention] This invention is alloy wax material which is used in order to join the metal or the nonmetal material in which the metal layer was formed on the metallic material or the front face and whose Sn is the main element, and relates to the alloy wax material used for junction which is expected to control the thickness of the wax material layer after joining.

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PRIOR ART

[Description of the Prior Art] In the assembly of a semiconductor device like a transistor or IC, as shown in drawing 1 , it may join to Cu or Cu using the alloy wax material which made Sn the subject on the substrate which performed nickel and Ag plating for the silicon chip in which the thin film of Au or Ag was formed at the rear face.

[0003] At this time, a wax material layer eases the stress which originates in the difference of the coefficient of thermal expansion of the silicon chip by the heat generated with intermittence actuation of a semiconductor chip, and a substrate, and is generated, and is bearing the important role of telling and radiating promptly the heat generated in it and coincidence to a substrate side. Since it becomes impossible to ease thermal stress when the wax material layer after this junction is too thin, and heat leakage nature will fall if too conversely thick, to make thickness of a wax material layer into for 10 to 100 micrometers is desired.

[0004] As a means to adjust a wax material layer to such thickness, there is an approach given [for example,] in JP,6-155081,A. Namely, the thickness of a solder layer is stabilized at the time of die bonding by putting the heat-resistant minute particle of predetermined particle size, such as a silica, in the middle of the solder of a bilayer.

[0005] However, it is necessary to use the solder which piled up another solder on it and was made to unify through a rolling mill, preparing two hoops of the solder once fabricated with strip processing in this case, and applying a minute particle to solder of one of the two.

[0006] However, after the usual alloy wax material for semiconductor device assemblies creates an ingot by dissolution casting, it is cast by the desired configuration through extruding, strip processing, and shearing-work ******.

[0007] For this reason, since said process which puts a minute particle is needed after strip processing, and a production process increases, wax material between which the heat-resistant minute particle was put has the problem that it cannot but become expensive compared with the conventional wax material.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, in order to make an intermetallic-compound particle intervene, by the alloy wax material of this invention, dispersion in the thickness of the solder layer obtained after junction becomes small. Moreover, since the alloy wax material of this invention is producible by the completely same production process as the conventional alloy wax material, it is not accompanied by the rise of a manufacturing cost. Therefore, the assembly yield can be improved in semiconductor device assembly, without raising member cost.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] From the above thing, this invention makes it a technical problem to provide at the cost which is not different from the former in the alloy wax material which has the function which can stabilize the thickness of the wax material layer after junction, without [therefore] increasing a processing process.

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MEANS

[Means for Solving the Problem] This invention which solves the above-mentioned technical problem is alloy wax material which makes Sn a subject, uses as the base the alloy wax material which contained 0.05 - 3.5% for Ag by weight concentration if needed, contains an element with decomposition temperature higher than the melting point of Sn 0.1% to 2.0%, and is characterized by being within the limits whose maximum grain size of the existing intermetallic compound is 5-80 micrometers.
[0010] Moreover, as an element with decomposition temperature higher than the melting point of Sn, it is desirable to coincidence that it is an element with an affinity weaker than Sn with oxygen, for example, Au, Cr, Co, Cu, nickel, Pd, Pt, Rh, Se, and Te are in it. Te is desirable at the simplicity of the handling also in being such.
[0011]
[Embodiment of the Invention] The maximum grain size of the intermetallic compound which the alloy wax material of this invention made Sn the subject, used as the base the alloy wax material which contained Ag in 0.05 - 3.5% or less of range if needed, and added the element which forms an intermetallic compound with decomposition temperature higher than Sn 2.0% from 0.1%, and was generated at the processing process is a thing within the limits which are 5-80 micrometers.
[0012] In order to obtain the wax material of this invention, after carrying out presentation preparation, fusing to a predetermined presentation and obtaining an ingot, extruding, strip processing, a shearing work, etc. carry out this ingot, and it considers as the alloy wax material of a desired configuration. Since the intermetallic compound generated in this process exists by the solid state even if it carries out melting of the wax material at the time of junction of a member, as shown in drawing 2 , the board thickness of the wax material layer after junction is controlled as it is also in that magnitude.
[0013] Furthermore, since this intermetallic-compound particle is a thing made to generate in the dissolution casting in the usual alloy wax material production process, it can supply wax material at the cost which a processing process does not increase, therefore is not different from the former.
[0014] In order to make an intermetallic compound generate in wax material and to control the particle size, the molten metal temperature at the time of dissolution casting is controlled. That is, once dissolving all raw material elements completely within crucible, if temperature is lowered gradually, an intermetallic compound with high melting temperature will crystallize from a molten metal. The intermetallic-compound particle crystallized as temperature was furthermore lowered grows, and is made big and rough.
[0015] Therefore, if it slushes into mold after holding molten metal to the temperature from which the crystallized intermetallic-compound particle serves as a desired particle size, or continuous casting is carried out, it quenches and growth of this particle is stopped, the ingot which the intermetallic-compound particle of the magnitude made into the purpose distributed in the alloy is producible. Although considered as the alloy wax material of a desired configuration through extruding, strip processing, a shearing work, etc. after that, since re-melting of the wax material is not carried out at these processing processes, the intermetallic compound generated at the time of ingot production will maintain magnitude as it is, and will be offered.
[0016] Thus, although the produced alloy wax material melts a matrix component with that melting point, the intermetallic compound with the melting point higher than this melting point does not dissolve. Therefore, since an intermetallic-compound particle will exist by the solid state at the time of junction, the thickness of the wax material layer after junction is secured with the particle size, and stable junction also with the small dispersion can be performed.
[0017] Since it is effective in wax material getting wet, and improving breadth nature or raising the mechanical

strength of wax material, Ag may be made to contain in the alloy wax material of this invention, although it is not necessary to necessarily contain Ag. However, since the compound with which Sn and Ag were connected will interfere with special effectiveness even if it added the 3rd element and controlled the particle size of an intermetallic compound, in order to be connected with Sn and to generate an intermetallic compound if Ag is also made into the addition exceeding 3.5%, to add Ag, it may be necessary to be 3.5% or less.

[0018] If the 3rd element to add is an element which forms an intermetallic compound with decomposition temperature higher than the melting point of Sn, it is fundamentally good anything. For example, as an element which forms Sn and an intermetallic compound, there are Au, Ba, calcium, Ce, Co, Cu, Fe, La, Li, Mg, Mn, nickel, Pr, Pt, Rh, Se, Sr, Te, Ti, Zr, etc. However, it is better to add the element which an affinity with oxygen is desirably weaker than Sn, namely, cannot oxidize easily rather than Sn. This is because the element oxidizes preferentially, it comes out to the front face of alloy wax material on the occasion of the production process way of alloy wax material, or use, an oxide film is formed and the purpose of an alloying element is not achieved, when the element which is easy to oxidize rather than Sn is added.

[0019] Moreover, although the junction which used alloy wax material is made when the metal of joint material and Sn in alloy wax material connect and alloy If the oxide film of other elements exists in an alloy wax material front face, in order to join without trouble's occurring in this alloying reaction and using an activator like flux for it especially in the assembly of a semiconductor device, It gets wet, and breadth nature gets worse or it is easy to become the factor out of which poor junction comes.

[0020] As an element which cannot oxidize easily rather than Sn among the above-mentioned elements, Au, Cr, Co, Cu, nickel, Pd, Pt, Rh, Se, and Te are raised. The melting point of Te in a simple substance is comparatively low especially, and since alloying is an easy element, without carrying out 2 phase separation when it added and dissolves in Sn, it is suitable as an alloying element.

[0021] However, since it becomes difficult for that addition to maintain at the range of 5 to 80 micrometers the maximum grain size of the intermetallic compound crystallized by controlling the temperature at the time of casting by less than 0.1% if an intermetallic compound does not crystallize, desired effectiveness is not acquired even if it changes various temperature at the time of casting, and 2.0% is exceeded in adding this 3rd element, it is necessary to make it 0.1 to 2.0% of within the limits.

[0022] Moreover, it will become difficult to radiate efficiently the heat which the case where the thickness of the wax material layer after junction will not fulfill 10 micrometers if the maximum grain size of the intermetallic compound to generate is smaller than 5 micrometers occurs, it becomes thickness inadequate for easing thermal stress, the thickness of the wax material layer after junction may exceed 100 micrometers if 80 micrometers is exceeded conversely, and is generated with a silicon chip to a substrate side. For this reason, a maximum grain size needs to make it the range of 5 to 80 micrometers.

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EXAMPLE

[Example] Next, this invention is further explained using an example.
(Examples 1-11) After blended with the alloy presentation shown in 1-11 of Table 1 (examples 1-11), putting into graphite crucible, dissolving in atmospheric air with the RF induction fusion furnace, casting Sn, Ag, and a tellurium to water-cooled mold at the casting temperature of the 1st table and making them into an ingot, thickness was set to 100 micrometers with extruding and strip processing, and it was processed by piercing for the square whose die length of one more side is 3mm.
[0024] Using these alloy wax material, in nitrogen-gas-atmosphere mind, it is on [of 270 degrees C] a heater block, and joined to the copper plate with which the silicon chip of the square whose die length of one side in which the golden vacuum evaporationo film was formed on substrate nickel and a front face is 5mm was given to plating of Ag on substrate nickel and a front face. The junction sample of ten points was produced to each alloy wax material, cross-section polish was performed, and the thickness of the solder after junction was investigated. Consequently, when it joined using this invention alloy wax material as shown in Table 2, the thickness of solder was secured with the intermetallic compound which exists in solder, and it turned out that dispersion in the thickness is small in the range whose addition of Te is 0.1 - 2.0%. In addition, in this example, it checked that the intermetallic compound with which Te is connected with Sn and becomes SnTe was formed by the X-ray microanalyser.
[0025] (Examples 1-4 of a comparison) After blended with the alloy presentation shown in the data numbers 12-15 of Table 1, putting into graphite crucible, dissolving in atmospheric air with the RF induction fusion furnace, casting Sn, Ag, and a tellurium to water-cooled mold at the casting temperature of the 1st table and making them into an ingot, thickness was set to 100 micrometers with extruding and strip processing, and it was processed by piercing for the square whose die length of one more side is 3mm. In addition, when 12 and 13 did not add Te or make it fewer than the range of this invention (examples 1 and 2 of a comparison), 14 and 15 are the cases (examples 3 and 4 of a comparison) where more Te than 2% is added.
[0026] The silicon chip was joined like the example using these alloy wax material. The junction sample of ten points was produced to each alloy wax material, cross-section polish was performed, and the thickness of the solder after junction was investigated. The result was shown in the data numbers 12-15 of the 2nd table. When it joined using this invention alloy wax material, thickness with the addition of Te sufficient by 0.05 or less was not obtained, but at 3.0% or more, it was too thick, and the table showed that dispersion also became very large. In addition, formation of the intermetallic compound which becomes SnTe also in this example of a comparison was checked.
[0027]
Table [ ] 1 sample Alloy presentation Casting temperature Particle size of a Sn-Te intermetallic-compound particle Number Unit: % of the weight Unit : [degree C] (20 points are measured to arbitration) Unit : micrometer Ag Te Sn The average Maximum Minimum value 1 3.0 0.1 Remainder 600 5.0 15.0 2.0 2 3.0 0.3 Remainder 600 8.5 20.0 4.0 3 3.0 0.3 Remainder 700 8.0 17.04.0 4 2.0 0.3 Remainder 600 8.5 18.0 3.5 5 3.0 0.5 Remainder 600 9.0 25.0 7.56 3.0 0.5 Remainder 700 9.0 20.0 5.0 7 2.0 0.5 Remainder 600 9.5 22.5 6.0 8 3.0 1.0 Remainder 600 15.0 32.5 7.5 9 3.0 1.0 Remainder 700 12.0 32.0 5.0 10 2.0 1.0 Remainder 600 17.0 35.0 7.5 11 3.0 2.0 Remainder 600 19.0 55.0 5.0 12 3.0 0 Remainder 600 It does not exist. It does not exist. It does not exist. 13 3.0 0.05 Remainder 600 1.2 2.0 1.0 14 3.0 3.0 Remainder 600 25.0 90.0 10.015 3.0 4.0 Remainder 600 30.0 125.0 10.0 [0028]
2nd Table Sample Alloy Presentation The thickness of the wax material layer after junction Number Unit : [% of the weight] (Thickness average for each core of ten samples) Unit : micrometer Ag Te Sn Average

Maximum Minimum value Dispersion 1 3.0 0.1 Remainder 12.0 24.0 10.014.0 2 3.0 0.3 Remainder 20.032.5 15.5 17.0 3 3.0 0.3 Remainder 17.5 25.0 15.0 10.0 4 2.0 0.3 Remainder 16.0 20.0 8.5 12.0 5 3.0 0.5 Remainder 30.0 35.0 16.0 19.0 6 3.0 0.5 Remainder 27.5 32.0 15.0 17.0 7 2.0 0.5 Remainder 32.0 30.0 17.5 12.5 8 3.0 1.0 Remainder 37.0 38.0 22.5 15.5 93.0 1.0 Remainder 35.0 35.0 25.0 10.0 10 2.0 The 1.0 remainder 38.0 40.0 24.0 16.0 11 3.0 2.0 Remainder 45.0 50.0 30.0 20.0 12 3.0 0 Remainder 5.0 15.0 1.0 14.0 133.0 0.05 Remainder 6.0 15.0 2.0 13.0 143.0 3.0 Remainder 42.5 80.0 27.0 43.0 15 3.0 4.0 Remainder 52.0 110.0 35.0 75.0

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the junction condition cross section of the silicon chip which used the conventional alloy wax material.
[Drawing 2] It is the junction condition cross section which used this invention alloy wax material.
[Description of Notations]
1 --- Silicon chip
2 --- Alloy wax material
3 --- Substrate
4 --- Intermetallic-compound particle

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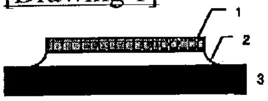
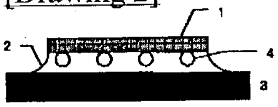
DRAWINGS

[Drawing 1]



[Drawing 2]



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